AMENDED SHEET

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CLAIMS

1. A security element (2) comprising a layer composite (1) with microscopically fine optically effective structures (9) of a surface pattern (12), which are embedded between transparent layers (4; 5; 6) of the layer composite (1), wherein the optically effective structures (9) are shaped into a reflecting interface (8) between the layers (5; 6) in surface portions (13; 14; 15; 46) of a security feature (16) in a plane of the surface pattern (12), which is defined by co-ordinate axes (x; y),

characterised in that

at least one surface portion (13; 14; 15) of dimensions greater than 0.4 mm has a diffraction structure (S; S*; S**) formed by additive or substractive superimposition of a superimposition function (M) describing a macroscopic structure, with a microscopically fine relief profile (R), wherein the superimposition function (M), the relief profile (R) and the diffraction structure (S; S*; S**) are functions of the co-ordinates (x; y) and the relief profile (R) describes a light-diffracting or light-scattering, optically effective structure (9) which, following the superimposition function (M), retains the predetermined relief profile (R), and that a central surface (33) defined by the at least portion-wise steady superimposition function (M) is curved at least in partial regions and at any point has a local angle of inclination (γ) predetermined by the gradient of the superimposition function (M), is not a periodic triangular or rectangular function and changes slowly in comparison with the relief profile (R).

2. A security element (2) as set forth in claim 1 characterised in that the superimposition function (M) is a portion-wise steady, periodic function with a spatial frequency (F) of at most 20 lines/mm.

3. A security element (2) as set forth in claim 1 characterised in that the superimposition function (M) is an asymmetrical, portion-wise steady,

periodic function with a spatial frequency (F) in the range of between 2.5 lines/mm and 10 lines/mm.

4. A security element (2) as set forth in claim 1 characterised in that adjacent extreme values of the superimposition function (M) in the surface portion (13, 14, 15) are remote from each other by at least 0.025 mm.

5. A security element (2) as set forth in one of claims 2 through 4 characterised in that the relief profile (R) is a diffraction grating (32) of constant profile height (h), which has a grating vector with an azimuth angle (φ) and with a spatial frequency (f) of greater than 300 lines/mm.

6. A security element (2) as set forth in one of claims 2 through 4 characterised in that the relief profile (R) is an anisotropic matt structure which has a preferred direction with an azimuth angle (φ).

7. A security element (2) as set forth claim 5 or claim 6 characterised in that the security feature (16; 16') has at least two adjacent surface portions (13; 14; 15) and that the first diffraction structure (S) is shaped in the first surface portion (14) and the second diffraction structure (S*; S**) which differs from the first diffraction structure (S) is shaped in the second surface portion (13; 15), wherein the grating vector or the preferred direction of the first relief profile (R) in the first surface portion (14) and the grating vector or the preferred direction of the second relief profile (R) in the second surface portion (13; 15) are directed substantially parallel.

8. A security element (2) as set forth in one of claims 5 through 7 characterised in that in the diffraction structure (S; S*; S**) the grating vector or the preferred direction of the relief profile (R) is substantially parallel to a gradient plane which is determined by the gradient (38) of the superimposition function (M) and a surface normal (21) which is perpendicular to the surface of the layer composite (1).

9. A security element (2) as set forth in one of claims 5 through 8 characterised in that shaped in a first surface portion (14) is the first diffraction structure (S) which is formed as the sum of the relief profile (R) and the superimposition function (M) and that shaped in a second surface portion (13; 15) is the second diffraction structure (S*) which is formed as the difference (R - M) of the same relief profile (R) and the same superimposition function (M).

10. A security element (2) as set forth in one of claims 5 through 9 characterised in that in the diffraction structure (S; S*; S**) the grating vector or the preferred direction of the relief profile (R) is substantially perpendicular to a gradient plane which is determined by the gradient (38) of the superimposition function (M) and a surface normal (21) which is perpendicular to the surface of the layer composite (1).

11. A security element (2) as set forth in claim 3 characterised in that the relief profile (R) is a diffraction grating (32) which has a grating vector with an azimuth angle (φ) and a spatial frequency (f) greater than 300 lines/mm, that the surface portion (13; 14; 15) in each period (1/F) of the superimposition function (M) is subdivided into a number t of partial surfaces (47) of the width 1/(F•t), that the diffraction grating (32) of the diffraction structure (S; S*;S**), which is associated with the one partial surface (47), differs in at least one of the grating parameters from the diffraction gratings (32) of the adjacent partial surfaces (47), that the subdivision and the occupation of the partial surfaces (47) with the diffraction structure (S; S*;S**) is repeated in each period (1/F) and that the diffraction grating (32) has the azimuth angle (φ) and/or the spatial frequency (F) corresponding to the local inclination (γ) in the surface portion (47) and that within each period (1/F) the grating parameters of the diffraction grating (32) step-wise or continuously traverse a predetermined azimuth angle range ($\delta\varphi$) or a predetermined spatial frequency range (δf) respectively.

12. A security element (2) as set forth in one of claims 5, 6 and 11 characterised in that in the first surface portion (14) the first diffraction structure (S) is formed from the sum of the relief profile (R) and the superimposition function (M) and that in the second surface portion (13; 15) the diffraction structure (S**) is the first diffraction structure (S) which is mirrored at the plane of the surface pattern (12).

13. A security element (2) as set forth in claim 5 characterised in that the diffraction structure (S) formed as the sum of the superimposition function (M) and the relief profile (R) is shaped in at least one surface portion (13; 14; 15), that the spatial frequency (f1) of the relief profile (R) is less than 2400 lines/mm and the superimposition function (M) has a local inclination (γ) measured in the diffraction plane (20) of the relief profile (R), that the surface portion (13; 14; 15) adjoins a background field (46) of the security feature (16), that the background field (46) parallel to the cover layer (4) has the central surface (33) with the inclination $\gamma = 0°$ into which a sinusoidal diffraction grating (32) with a second spatial frequency (f2) and with a grating vector oriented in parallel in the diffraction plane (20) of the relief profile (R) is shaped, that the second spatial frequency (f2) is so selected that upon perpendicular illumination with white light (11) in the one viewing direction at a predetermined positive viewing angle ($+\vartheta$) the surface portion (13; 14; 15) and the background field (46) do not differ in respect of the color of the diffracted light and that after a 180° rotation of the layer composite (2) about the surface normal (21) at the negative viewing angle ($-\vartheta$) the surface portion (13; 14; 15) and the background field (46) differ in respect of the color of the diffracted light.

14. A security element (2) as set forth in claim 1 characterised in that the relief profile (R) is an isotropic matt structure.

15. A security element (2) as set forth in claim 14 characterised in that the superimposition function (M) describes a relief image.

16. A security element (2) as set forth in claim 14 characterised in that the superimposition function (M) describes a portion of a sphere.

17. A security element (2) as set forth in one of claims 1 through 16 characterised in that the diffraction structure (S; S*; S**) is restricted to a structure height (H_{St}) of less than 40 μm and the superimposition function (M) is restricted to a variation value (H) of less than 30 μm, wherein the value (z) of the superimposition function (M), which is used in the diffraction structure (S; S*; S**) is equal to {(M) + C(x; y)} modulo variation value (H) - C(x; y), wherein the function C(x; y) is restricted in amount to half the structure height (H_{St}).

18. A security element (2) as set forth in one of claims 1 through 17 characterised in that further surface elements (17; 18; 19) having the optically effective structures (9) are parts of the surface pattern (12) and that at least one of the surface elements (17; 18; 19) adjoins the security feature (16).

19. A security element (2) as set forth in one of claims 1 through 18 characterised in that arranged on at least one of the surface portions (13; 14; 15) is at least one identification mark (37) with an optically effective structure (9) differing from the diffraction structure (S; S*; S**) and that the identification mark (37) which can be used as a reference for orientation of the layer composite (1) has one of the optically effective structures (9) from the group of diffractive or light-scattering relief structures or a mirror surface.